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MEDIAC:
An On-Line Media Planning System

346-68

Leonard M. Lodish
John D. C. Little

June 1, 1968

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Abstract

MEDIAC is an implemented on-line computer system which selects and schedules advertising media. The system is based on a market response model and a heuristic search routine, and is composed of several interactive programs which are operated from a remote console of a time shared computer. The process of implementing MEDIAC resulted in changes both to the system and its users. The underlying models have become more complex and the heuristic routines have been made more efficient. The users have tended to change the emphasis of their efforts in media planning.

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1. Introduction

The problem of media planning in advertising is a natural one for the application of mathematical models and computers. A great deal of data is available on who reads (or sees or hears) what. There is considerable data on what kinds of people are prospects for which types of product. There are many different media options available. Many judgments must be made. It would seem that there should be some organized way of combining judgments and data into a model, setting an objective, and then optimizing it to produce a good media plan.

Indeed, a number of people and organizations have tried to do this. (A review of published work may be found in Little and Lodish [1].) We here report on a model that we have constructed and brought up as an on-line media planning system. Since May 1967 the system has been available on a commercial basis under the name MEDIAC. The implementation of MEDIAC has brought about evolutionary changes both in the system and its users. Interaction with media planners has led to an increase in both the complexity of the model and the operating efficiency of the system. At the same time the media planners have changed their methods of planning due to exposure to MEDIAC.

In this paper we shall briefly describe the model, its optimization, and the computer system. Then we shall give an example of an application and discuss some of our experiences with the system.

2. Model

The media planning problem may be stated as follows: Given a set of media options, a budget, and various data about the media and the

audience to be reached, which options should be used and when should they be used in order to maximize profit or some related measure of performance? By a media option we ordinarily mean a detailed specification of the place, position, size, and other outward characteristics of an advertisement, but not the message and copy treatment. Thus, the role of media in the advertising process is to expose a chosen audience to the advertiser's messages in an efficient manner.

Relevant to this objective are at least the following phenomena:

- Market segmentation
- Sales potential of individual segments, i.e. their relative importance to the advertiser
- Media coverage in each segment
- Overlaps in media audiences, both across media and across time
- Forgetting by those exposed to the ads
- Diminishing returns at high exposure rates
- Media costs
- Intermedia differences in the value of an exposure
- Seasonality of sales potential and audiences

The purpose of our model is to combine the above phenomena into a flexible, consistent structure which the media planner can use to evaluate alternative media plans and concepts. The model will be verbally described below. For a detailed technical description, see [1].

First, it is supposed that market segments have been defined. Perhaps men and women have different sales potential and therefore represented as different segments. In addition, perhaps these are each broken down further into geographic regions and income classes. Segments may be defined in any

manner as long as suitable media coverage data can be supplied for them.

Second, an advertising insertion in a given medium creates a probability of exposure for a person in a specified market segment. The probability of exposure depends on the audience of the medium within the segment, and on the size, length, color, or other characteristics of the insertion. The exposure of a person to a medium is not independent of exposure to other media or to the same medium at another time, but depends on media overlap probabilities.

Third, the advertising exposure creates value in the people exposed, i.e. disposes them more toward buying the product. The amount of value created by one exposure depends on the medium and is called the exposure value of the medium.

Fourth, people forget. It is usually assumed that people forget a constant percentage of exposure value in each time period although more complicated relations are possible. Figure 1 shows how the retained exposure value of an individual might change with time.

Finally, people act. As the level of exposure for a person rises, so does the anticipated response, but it does so with diminishing returns. The relationship might be as shown in Figure 2.

The anticipated total response in a time period is the sales potential of each market segment times the average percent of potential achieved by people in that segment summed over all segments. The average percent of potential achieved in a segment is calculated by an analytic approximation that involves the characteristics of the probability distribution of exposures to people within the segment. Thus the model, a simulation by some definitions, is not a simulation in the sense that individuals in a population are treated one at a time by the computer.

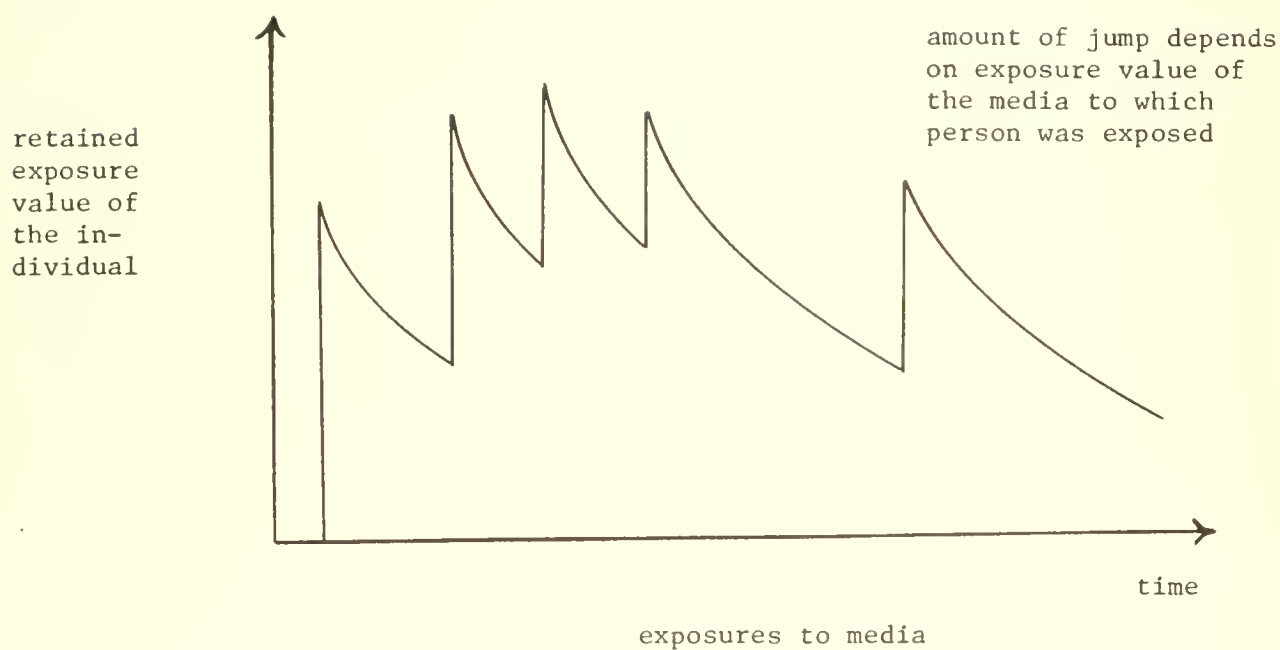


Figure 1. Retained exposure value as it might vary over time for a specific individual.

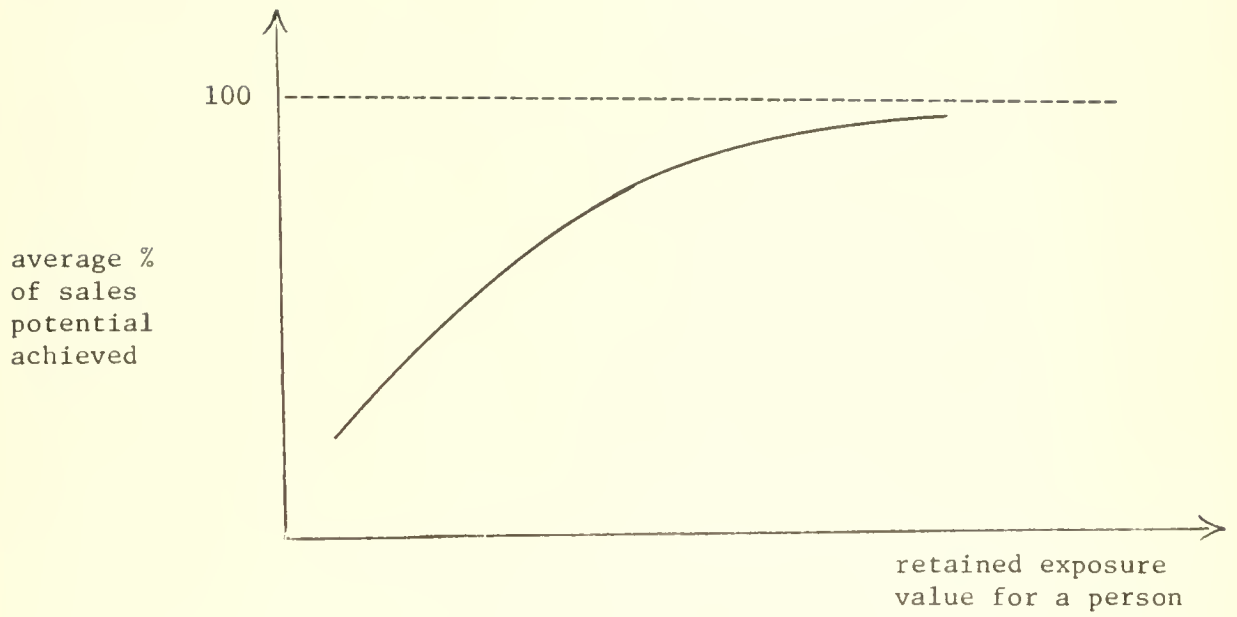


Figure 2. Customer response.

To summarize: advertising insertions in media generate exposures in the market segments. Exposures have value and raise the exposure level of some people in the segments, although this will decrease with time because of forgetting unless further exposures occur. The exposure level generates an anticipated response. Diminishing returns occur at high exposure levels.

3. Optimization

Heuristic methods are used to select and schedule media for large total response. The exact optimization problem is one of integer programming with a nonlinear objective function. Efficient exact methods are not available for this, but fairly simple heuristics appear to give very good results. The present routine starts from the set of required media (if any) and adds new media one at a time according to a criterion of largest incremental response per dollar, taking into account all media inserted up to that point. The routine stops when the budget is exhausted.

4. Computer System

The current version of MEDIAC contains four conversational programs which the user may call at his option:

- (1) INPUT accepts data from a teletype and stores it on a disk file. The required data and its format are requested by the computer in English. The user may elect options which help to eliminate repetitions of certain input.
- (2) CHANGE enables the user to change any stored data on the disk.
- (3) PRINT prints out the input data stored on disk in a management report format.
- (4) MEDIAC is the actual calculation program. Its input is a disk file prepared by INPUT or CHANGE. The user may use three

different options in this program. He may request:

1. Evaluation of a particular schedule in terms of its expected response in total and its effects in each market segment and time period.
2. Initial Ranking of all available media options. This is based on the incremental value per dollar for each option in the absence of others in the schedule. The rankings can serve as an effective initial media screening device.
3. Selection and Scheduling of the media options. A detailed output of the effects of the generated schedule in each market segment during each time period is also generated at the user's option as well as a chart of the schedule by time periods.

The system is up on a time share computer utility with which users communicate via telephone lines. MEDIAC represents a step beyond the computer utility toward a mathematical model utility.

5. Example

The following example is a slightly-coded and cut-down version of an actual application. The run was made as part of the planning process in the development of a television schedule.

The product at hand is used almost exclusively by women. We have dubbed it "Princess Widgets." Heaviest use is among women aged 25-34 in A (i.e. metropolitan) counties, although significant usage is found in other groups. The relevant market segments have been broken out by age and county type as follows:

Age: 25 and under / 25-34 / 35-49 / 50-64

County type: A / B / C + D (abbreviated C)

All twelve combinations are considered. Existing TV shows representative of types expected to be available in the planning period are used in the analysis. The shows selected for consideration have been chosen with the objective of permitting a mix that will cover high potential groups efficiently. The media abbreviations are:

ASOAPD = Daytime Serial A

NADVEN = Night Adventure

BSOAPD = Daytime Serial B

NSITUA = Night Situation

DAGAME = Daytime Game

FRINGA = Fringe Spots in
County Size A

NMOVIE = Night Movie

FRINGB = Fringe Spots in
County Size B

The following pages give a summary of input data for the problem and an abbreviated transcript of the console session at which this problem was run. Included are:

- (1) Input of the data.
- (2) Preliminary ranking of the media choices.
- (3) Detailed build up on the schedule for the given budget and other input.
- (4) Summary of final schedule.
- (5) Detailed results of retained exposure value by market segment and time period.

TABLE I: INPUT DATA

PRODUCT: PRINCESS WIDGETS

Budget \$600,000

5 Periods

12 Segments

9 Media

Media Data

Media Option	ASOAPD	BSOAPD	DAGAME	NMOVIE	NWESTN	NADVEN	NSITUA	FRINGA	FR
Cost/Insertion	6800	11100	7300	55000	46400	37900	46000	5000	40
Exposure Value	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Probability of Exposure	.35	.35	.35	.40	.40	.40	.40	.35	.35
Upper Bounds	12	8	12	4	4	4	4	40	40

Audience Seasonality: None

Segment Data

Market Segment	A 25 Und	A 25-34	A 35-49	A 50-64	B 25 Und	B 25-34	B 35-49	B 50-64	C 25 Und	C 25-34	C 35-49	C 50-64
Population	4000	4470	6930	5860	2810	3140	4880	4120	3490	3910	6060	5120
Sales Potential	1.56	1.43	1.33	.98	1.49	1.36	1.25	.90	1.20	1.10	1.01	.72
Initial Exposure Value/ Person	.100	.098	.082	.064	.101	.095	.082	.061	.085	.083	.070	.056

Potential Seasonality: None

Other Data

Memory Constant: .250

% Potential Realized at Saturation: 100.

1 Average Exposure: 50.

2 Exposures: 70.

3 Exposures: 80

MARKET COVERAGES

	A 25und	A 25-34	A 35-47	A 50-64	B 25und	B 25-34	B 35-47	B 50-64	C 25und	C 25-34	C 35-49	50
ASOAP	.096	.068	.056	.052	.104	.073	.060	.056	.115	.081	.067	.056
BSOAP	.111	.096	.075	.079	.104	.090	.071	.074	.139	.120	.094	.081
DAGAME	.093	.085	.081	.089	.103	.094	.090	.098	.096	.088	.084	.079
NMOVIE	.321	.313	.249	.206	.302	.294	.235	.194	.274	.266	.212	.187
NWESTN	.129	.051	.104	.114	.144	.102	.116	.127	.208	.147	.167	.140
NADVEN	.209	.211	.192	.101	.241	.242	.220	.116	.166	.167	.153	.137
NSITUA	.272	.245	.205	.208	.241	.217	.182	.184	.205	.185	.155	.140
FRINGA	.120	.120	.100	.080	.000	.000	.000	.000	.000	.000	.000	.000
FRINGB	.000	.000	.000	.000	.120	.120	.100	.080	.000	.000	.000	.000

MEDIA DUPLICATIONS

	ASOAPD	BSOAPD	DAGAME	NMOVIE	NWESTN	NADVEN	NSITUA	FRINGA	FRINGB
ASOAPD	.036	.037	.035	.040	.034	.035	.037	.025	.025
BSOAPD		.048	.042	.051	.047	.048	.050	.041	.041
DAGAME			.043	.047	.042	.044	.046	.038	.038
NMOVIE				.133	.054	.059	.090	.050	.050
NWESTN					.067	.050	.070	.046	.046
NADVEN						.078	.071	.048	.048
NSITUA							.097	.050	.050
FRINGA								.050	.050
FRINGB								.050	.050

TYPE DUPLICATIONS OF ASOAPD WITH
 ASOABSOADAGANMOVIEFRINGAADVNSITERINFRIN
 .XXX.XXX.XXX.XXX.XXX.XXX.XXX.XXX.XXX
 — .036.037.035.040.034.035.037.035.025

STOP

The data bank for this
 problem is now created.

The user then asks for an
 initial ranking of all the
 media options

— -GO (G2A011)/@MEDIAC/

TYPE 1 IF INITIAL EXPOSURES ARE ZERO, OTHERWISE 2

— 1,

TYPE 1 IF RANKING WANTED, 2 FOR FULL ALLOCATION

— 1,

DAGAME	T. P.	1	IMPACT/DOL=	.151
DAGAME	T. P.	2	IMPACT/DOL=	.151
DAGAME	T. P.	3	IMPACT/DOL=	.151

⋮

ASOAPD	T. P.	1	IMPACT/DOL=	.133
--------	-------	---	-------------	------

⋮

FRINGA	T. P.	1	IMPACT/DOL=	.123
--------	-------	---	-------------	------

⋮

BSOAPD	T. P.	1	IMPACT/DOL=	.107
--------	-------	---	-------------	------

⋮

NMOVIE	T. P.	1	IMPACT/DOL=	.067
--------	-------	---	-------------	------

⋮

NADVEN	T. P.	1	IMPACT/DOL=	.065
--------	-------	---	-------------	------

⋮

NSITUA	T. P.	1	IMPACT/DOL=	.065
--------	-------	---	-------------	------

⋮

FRINBG	T. P.	1	IMPACT/DOL=	.054
--------	-------	---	-------------	------

⋮

NWESTN	T. P.	1	IMPACT/DOL=	.039
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⋮

COMPUTER TIME	.09 MINUTES
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STOP

This time the user desires
a full run of the MEDIAC
selection and
scheduling system.

— -GO (G2A011)/@MEDIAC/

TYPE 1 IF INITIAL EXPOSURES ARE ZERO, OTHERWISE 2

— 2,

TYPE INITIAL EXPOSURES/CAP. IN SEGMENTA25UND F4.

— .1,

·
·
·

TYPE 1 IF RANKING WANTED, 2 FOR FULL ALLOCATION

— 2,

TYPE 1 IF SOME MEDIA HAVE ALREADY BEEN SELECTED, OTHERWISE 2

— 2,

If some media must be in the
schedule, they are added here

1	INSERT	IN	DAGAME	TIME	PER	5	COST	73000	REALIZED	POT.	4797.
1	INSERT	IN	DAGAME	TIME	PER	3	COST	146000	REALIZED	POT.	5913.
1	INSERT	IN	DAGAME	TIME	PER	2	COST	219000	REALIZED	POT.	6996.
1	INSERT	IN	DAGAME	TIME	PER	4	COST	292000	REALIZED	POT.	8055.
1	INSERT	IN	DAGAME	TIME	PER	1	COST	365000	REALIZED	POT.	9094.
1	INSERT	IN	DAGAME	TIME	PER	5	COST	438000	REALIZED	POT.	10056.
1	INSERT	IN	DAGAME	TIME	PER	2	COST	511000	REALIZED	POT.	11004.
1	INSERT	IN	DAGAME	TIME	PER	4	COST	584000	REALIZED	POT.	11926.
1	INSERT	IN	DAGAME	TIME	PER	1	COST	657000	REALIZED	POT.	12838.
1	INSERT	IN	DAGAME	TIME	PER	3	COST	730000	REALIZED	POT.	13725.
1	INSERT	IN	DAGAME	TIME	PER	1	COST	803000	REALIZED	POT.	14537.
1	INSERT	IN	DAGAME	TIME	PER	3	COST	876000	REALIZED	POT.	15322.
1	INSERT	IN	DAGAME	TIME	PER	5	COST	949000	REALIZED	POT.	16150.
1	INSERT	IN	DAGAME	TIME	PER	2	COST	1022000	REALIZED	POT.	16894.
1	INSERT	IN	DAGAME	TIME	PER	4	COST	1095000	REALIZED	POT.	17638.
1	INSERT	IN	DAGAME	TIME	PER	1	COST	1168000	REALIZED	POT.	18329.
1	INSERT	IN	DAGAME	TIME	PER	3	COST	1241000	REALIZED	POT.	18966.
1	INSERT	IN	DAGAME	TIME	PER	5	COST	1314000	REALIZED	POT.	19673.
1	INSERT	IN	DAGAME	TIME	PER	2	COST	1387000	REALIZED	POT.	20276.
1	INSERT	IN	DAGAME	TIME	PER	1	COST	1460000	REALIZED	POT.	20855.
1	INSERT	IN	DAGAME	TIME	PER	4	COST	1533000	REALIZED	POT.	21457.
1	INSERT	IN	DAGAME	TIME	PER	1	COST	1606000	REALIZED	POT.	21955.
1	INSERT	IN	DAGAME	TIME	PER	3	COST	1679000	REALIZED	POT.	22449.
1	INSERT	IN	DAGAME	TIME	PER	4	COST	1752000	REALIZED	POT.	22947.
1	INSERT	IN	DAGAME	TIME	PER	2	COST	1825000	REALIZED	POT.	23395.
1	INSERT	IN	DAGAME	TIME	PER	5	COST	1898000	REALIZED	POT.	23967.
1	INSERT	IN	NMOVIE	TIME	PER	3	COST	2448000	REALIZED	POT.	26950.
1	INSERT	IN	NMOVIE	TIME	PER	5	COST	2998000	REALIZED	POT.	30002.
1	INSERT	IN	DAGAME	TIME	PER	1	COST	3071000	REALIZED	POT.	30393.
1	INSERT	IN	NMOVIE	TIME	PER	2	COST	3621000	REALIZED	POT.	33270.
1	INSERT	IN	NMOVIE	TIME	PER	4	COST	4171000	REALIZED	POT.	36129.
1	INSERT	IN	NMOVIE	TIME	PER	1	COST	4721000	REALIZED	POT.	38898.
1	INSERT	IN	NMOVIE	TIME	PER	3	COST	5271000	REALIZED	POT.	41519.
1	INSERT	IN	NMOVIE	TIME	PER	1	COST	5821000	REALIZED	POT.	44080.
1	INSERT	IN	NMOVIE	TIME	PER	4	COST	6371000	REALIZED	POT.	46679.

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MEDIAC GENERATED SCHEDULE

MEDIA PER.	1	2	3	4	5
DAGAME	7	6	6	6	6
NMOVIE	XX	X	XX	XX	X

The system prints a trace of the build up of the schedule and then a graphical display of the final schedule.

TYPE1 FOR DETAILED OUTPUT, ELSE2

—1,

SEGMENT	TIME	P	EX	VAL/CP	SEG E.V.	REALIZED	POTENTIAL
A2SUND	1			.58410	2336.	1248.	
A2SUND	2			.43682	1747.	960.	
A2SUND	3			.52831	2113.	1108.	

The user desires to see detailed output describing average retained exposure level/person and realized potential in each segment during each period of the analysis.

COMPUTER TIME . MINUTES

STOP

+

— -LOG

TIME USED 0:42:27

Total time used, including input, was 42 minutes of terminal time and .97 minutes of CPU time.

A few comments are worth making on the final schedule. Under the conditions of the problem, daytime shows covered the desired audience most efficiently. (See initial rankings.) As a result, the computer took the highest ranking daytime show, DAGAME, and used a considerable amount. If higher diminishing returns had been used, less DAGAME would have been scheduled because of its duplication with itself. After using considerable DAGAME, the computer skipped over the other daytime shows to the much lower ranked NMOVIE. This is because NMOVIE picks up new people not covered well by daytime TV. If the budget had been substantially larger, more media would probably have come in. The media director whose problem this is thought that fringe spots would be useful. However, even when their exposure value was increased slightly and their cost decreased slightly in a sensitivity test, they did not come into the schedule. Apparently, after the other shows have been carefully picked, the spots have little to offer in this situation.

6. Discussion

What have we learned from the exposure of our model and system to media planners?

Real world problems are viewed as large and analytically complex by those responsible for solving them, even though their past approaches have been analytically quite simple. We are constantly being pressed to increase our capacity particularly with respect to number of media alternatives, market segments and time periods. We have increased our capacity from 15 media, 20 segments, and 12 time periods to 25 media, 20 segments and 13 time periods and are currently working on a much larger version.

Although our system is computationally very efficient compared, say, to a simulation approach to media evaluation, we feel economic pressure to make the system and heuristics run faster so that bigger problems become feasible in relation to the research budgets of the users. We have made the system at least three times faster in the past year for medium sized problems and even faster relatively for problems as they become larger.

An unwelcome consequence of larger problems is that they become less practical to operate on a time shared basis. In some busy periods the user may wait for three or four hours for a run taking twenty minutes of central processor time. To overcome this we have set up a system of on-line ordered batch processing for these large problems. The user still runs the conversational input, change and print programs at the console to enter his data or make any data changes. He then calls another conversational program which constructs a disk file containing instructions for the options desired in the calculation program. The calculation program is run overnight in a batch mode and creates a disk file with the system output. The user then enters the time-sharing system in the morning and prints out the results at his terminal.

We have also felt pressure to include more phenomena in our model of the advertising process. We presently are working on including competitive advertising, the rub-off effect of other advertising by the same firm, and the synergistic effects of multiple media types. The research is constantly prodded by our users asking for the inclusion of new phenomena. When these phenomena are included, they will undoubtedly ask for others.

At the same time, we have the distinct impression that we should not introduce complications too fast. Although the concepts in our model

are all familiar to media planners, the process of developing data on each and putting them all into a single structure is not easy and requires time to absorb. This must be done for the most basic phenomena before going on to new complexities.

The interactive aspect of our system has been valuable in building confidence in the system among non-technical users. The user directly monitors what goes in to the computer without being subjected to the rather imposing tribal rituals demanded by punched cards, system programmers, and computer operators. The user feels that the system is in his control at all times and he knows exactly what data the computer is using to work on his problem. If any input mistakes are involved, he holds himself responsible. Most people seem to have more confidence in themselves than in other interfaces with the computer.

How has the use of MEDIAC affected the way our users think about their media planning decisions? MEDIAC tends to move the intuitive approach of the media planner to a more productive level. More effort goes into formulating the problem constructively than into trying to perceive the answer in one jump. Not that users automatically accept the model's answers, they test the answers against their intuition, dig into the model to find out what caused any substantial discrepancies and, in the process, appear to be updating and enriching their intuition.

The use of a rather comprehensive model structure has caused some planners to face problems whose importance had previously been unacknowledged. For example, one user tried three different response functions for a problem, one reflecting very high diminishing returns with repeated exposure, the second a moderate amount of diminishing returns, and the third almost

no diminishing returns. The MEDIAC generated schedule was quite different for each curve. The importance of defining his client's objectives in terms of the value of repeated exposure was thus dramatized by sensitivity analysis on the model.

The model tries to give the users a sensible, consistent, comprehensive structure for media planning. The model leads people to look at many issues and ferret out information on all of them. It also helps sort out relevant material from the deluge of data which planners invariably encounter.

Preparing problems for MEDIAC is often time consuming. Collecting the input data can be a time-consuming undertaking. A substantial amount of data manipulation is often needed because the data sources are frequently incomparable, the numbers are in different units, or the data must be extrapolated. We have made some headway into computerization of the data manipulation problem and consider it a fruitful area for development. Once the planner has done a few problems he usually finds short-cuts in input generation which save considerable amounts of time. Obtaining input for an average problem by an experienced MEDIAC user has taken from one to three man days.

Users have been quite pleased with the results they have achieved with MEDIAC. Improvements in the objective functions, as defined by the users, have ranged from about 5% to 25% relative to previous schedules. Some MEDIAC generated schedules have looked much like previous ones; others have been quite different. In cases that have looked different, it has been possible to find out what data or phenomena have caused the change. In almost all cases the media planner has preferred the new schedule.

References

1. J. D. C. Little and L. M. Lodish, "A Media Selection Calculus"
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